

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

"APPROVED"
Vice-rector
on educational and methodic work

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Geoinformation systems and big data in economic research

syllabus of the discipline

Knowledge branch	<i>all</i>
Speciality	<i>all</i>
Academic degree	<i>first (bachelor)</i>
Academic program	<i>all</i>

Type of the academic discipline	<i>selective</i>
The language of teaching, training and assessment	<i>English</i>

Head of the department
of Tourism

Olena SUSHCHENKO

Kharkiv
2021

APPROVED
at the meeting of the Department of Tourism
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Letter of renewal and re-approval of the syllabus of the academic discipline

Academic year	Date of the Department of Tourism meeting	Minutes number	Signature of the Head of the Department

Annotation of the academic discipline

Conducting economic research at the present stage is impossible without the use of information technology in the process of planning and organizing the activities of both individual enterprises, industries and integrated clusters. Today, geographic information systems are the basis for the design of logistics routes, databases of cadastral objects, navigation applications, and the processing of data obtained via the analysis of the preferences of large consumers. Various solutions offered at the levels of developers and consumers of products and various sectors of the national economy solve a number of problems to ensure data security and transmission, search for geospatial information, the integration of certain standard functions into a complex product. The range of GIS applications is extremely wide - from online maps with minimal navigation services to support of the international transport system, which includes passenger and freight traffic. Continuous improvement of navigation devices and their gradual introduction to the mass market create favourable conditions for the development of a new generation of software focused on individual use. An important trend is also the integration of different applications with specific functions into one software product that can provide a wide range of demands from developers and consumers. The processing of large data sets received from economic entities allows to obtain optimal management decisions in a timely manner and to work out a business development strategy for constant market monitoring.

The object of studying the discipline are ways to use geographic information technologies and big data to solve problems of organization of economic research.

The aim of teaching the discipline is the peculiarities of the practical implementation of geographic information technologies and the basics of designing databases of geographic information systems using the software product QGIS.

The purpose of the discipline is formation of a system of theoretical knowledge and applied skills to substantiate the necessary conditions and objectives of economic research at the macro and micro levels, taking into account trends and threats to the world market and strategic priorities of the state in economic security, increasing the efficiency of local development projects using big data.

Characteristics of the discipline

Academic year	2 / 3
Semester	3 / 4 / 5 / 6
Number of ECTS Credits	5
Final assessment	test

Structural-logical scheme of the discipline learning

Prerequisites	Postrequisites
Informatics Statistics	All disciplines that provide analysis of economic activity of market participants

Competencies and learning outcomes of the discipline

Competence	Learning outcomes
Knowledge of theoretical background and principles of creation of digital geographical maps, understanding typical tasks of standard applied programs on the basis of geoinformation technologies	Gain skills in working with typical geographic information systems based on vector maps and relational databases
Knowledge of the theoretical basis and principles of global navigation systems, methods of tracking the movement and positioning of objects in three-dimensional and two-dimensional space	
Ability to process geospatial data and populate databases to vector maps	
Ability to calculate the cost of projects using geographic information technologies; skills of visualization and analysis of geospatial data	
Ability to build ready-made maps based on individual project requirements	
Knowledge of procedures for collecting, storing and processing large data sets from economic entities (producers, suppliers and consumers of products)	Use geoinformation technologies and big data in economic research
Ability to determine requirements for software products and services based on geographic information technologies used by manufacturers and users of services in the field of logistics (freight and passenger transportation)	
Ability to create analytical presentations based on cartographic information	
Skills of creating individualized maps	
Knowledge of the theoretical background of cadastral zoning and the working out regional programs for the development of administrative units; ability to design a comprehensive local infrastructure	
Ability to work with standard online services that provide an interactive mode of data entry	
Ability to initiate, develop and implement projects for large-scale statistical research and integration of the satellite account system in the process of obtaining data sets	

The program of the academic discipline

Content module 1

Basics of geoinformation technologies

Theme 1. Digital cartography

Theme 2. Principles of navigation systems. Global positioning systems

Theme 3. Processing of analytical data

Theme 4. GIS hardware and software requirements. Stages of spatial design

Theme 5. Online services based on geoinformation technologies

Content module 2

Use of geoinformation technologies in economic research

Theme 6. Requirements for the organization and processing of geospatial information in different industries

Theme 7. Modelling of geospatial tasks. Methods of data visualization

Theme 8. Types of spatial data and methods of computer presentation of geographical information

Theme 9. Cadastral zoning and territorial development planning

Theme 10. Integration of GIS with other tourist services

Content module 3

Basics of working with big data

Theme 11. Theoretical aspects of big data research

Theme 12. Legal regulation of the open data usage

Theme 13. The use of a system of satellite accounts in economic research of production and consumption of certain types of goods and services

Theme 14. The use of big data arrays in social programs

Theme 15. Development of a data collection project to monitor the behaviour of market participants

The list of laboratory works

Content module 1

Basics of geoinformation technologies

Laboratory work 1: "Introduction to the interface of the geographic information system QGIS v. 3.x and its main functions. Configuring the workspace and main toolbars"

Laboratory work 2: "Preparation of statistical data for processing. Visualization of geographical maps based on analytical information. Working with map layers"

Laboratory work 3: "Complex queries and tools for processing fields and attribute table entries"

Laboratory work 4: "Additional tools for data visualization. Construction of analytical graphs and charts based on geospatial information"

Laboratory work 5: "Creating maps with QGIS tools based on consumer requirements. Preparing maps for printing using the Print Layout module"

Content module 2

Use of geoinformation technologies in economic research

Laboratory work 6: "Connection of additional QGIS modules. Integration with OpenStreetMap, Google Maps. Using the XYZ Tiles plugin"

Laboratory work 7: "Methods of digitization of raster maps. Selection of topographic standards"

Laboratory work 8: "Adding objects to the map based on the selected coordinate system. Working with point, linear and polygonal layers"

Laboratory work 9: "Merging maps. Working with objects that have common borders or intersections"

Laboratory work 10: "Introduction to the Google Earth project. Tools and data types"

Content module 3

Basics of working with big data

Laboratory work 11: "Fundamentals of work in the R Studio application. Downloading data, installing libraries, calculating indicators via manual input of formulas"

Laboratory work 12: "Methods of data visualization. Graphing in R Studio"

Laboratory work 13: "Principles of creating concept maps. Construction of a relational database scheme in the online application Lucidchart"

Laboratory work 14: "Fundamentals of business process modelling using IDEF methodology and BPMN notation method in the online application Lucidchart. Building a decision tree. Introduction to DFD diagrams for depicting information flows"

Laboratory work 15: "Creating a project layout in the application ProjectLibre. Construction of a Gantt chart, calculating the cost by stages of work"

Teaching and learning methods

In the process of teaching the discipline both active and interactive learning technologies are used to enhance the educational and cognitive activities of students.

Distribution of forms and methods to enhance the process of studying by themes of the discipline

Theme	Practical use of learning technologies
Theme 1. Digital cartography	<i>Mini-lecture</i> "Common approaches in design, 3D modelling and mapping". <i>Visual support banks</i> (offline and online vector maps)
Theme 2. Principles of navigation systems. Global positioning systems	<i>Mini-lecture</i> "Satellite communication systems. <i>Case</i> "Positioning of Ukraine in the global market of navigation systems. Stimulating the introduction of innovative technologies in production and education"
Theme 3. Processing of analytical data	<i>Lecture-discussion</i> "Effective ways to present the results of analytical research of economic phenomena and processes." <i>Visual support banks</i> (visualization of indicators of economic activity of market participants)
Theme 4. GIS hardware and software requirements. Stages of spatial design	<i>Mini-lecture</i> "Classification of geo-referencing systems. Contradictions between national and international standards". <i>Visual support banks</i> (four main types of geo-referencing systems on the earth's surface. Different types of coordinate systems)
Theme 5. Online services based on geoinformation technologies	<i>Mini-lecture</i> "Creating interactive multi-layered online maps". <i>Visual support banks</i> (examples of online services integrated with GIS in various industries, such as fossil resource maps, historical and cultural epochs, recreational resources, etc.)
Theme 6. Requirements for the organization and processing of geospatial information in different industries	<i>Lecture-discussion</i> "The best online maps for business process planning. Criteria for evaluating existing solutions. Is it necessary to unify the description procedure?" <i>Visual support banks</i> (examples of online maps OpenStreet, Google, Bing, etc.)
Theme 7. Modelling of geospatial tasks. Methods of data visualization	<i>Mini-lecture</i> "Topographic survey of the area." <i>Visual support banks</i> (topographic equipment).
Theme 8. Types of spatial data and methods of computer presentation of geographical information	<i>Lecture-discussion</i> "Optimal structure of the geospatial data package". <i>Visual support banks</i> (historical development of GIS standards, examples of vector maps in different formats - shapefile, geolite, etc.)
Theme 9. Cadastral zoning and territorial development planning	<i>Mini-lecture</i> "Cadastral map of Ukraine". <i>Case</i> "Implementation of smart city "technologies in logistics flow planning". <i>Visual support banks</i> (official New York city development plans)
Theme 10. Integration of GIS with other tourist services	<i>Mini-lecture</i> "An example of the work of logistics systems integrated with geographic information data. Creation of transport hubs (on the example of Luxembourg)". <i>Visual support banks</i> (online resources for route planning and calculation of freight costs)
Theme 11. Theoretical aspects of big data research	<i>Lecture-discussion</i> "Ensuring open access to big data in order to increase the competitiveness of small and medium-sized businesses." <i>Visual support banks</i> (examples of tables of economic indicators by observation units of different levels)
Theme 12. Legal regulation of the open data usage	<i>Lecture-discussion</i> "The problem of preserving the privacy of these market participants during the collection of indicators of economic activity." <i>Visual support banks</i> (normative documents of Ukraine and

Theme	Practical use of learning technologies
	international public law)
Theme 13. The use of a system of satellite accounts in economic research of production and consumption of certain types of goods and services	<i>Mini-lecture</i> "Examples of using the system of satellite accounts by different countries". <i>Case</i> "Development of a procedure for collecting primary data. Software selection and requirements for the design of information processing systems coming from statistical observation units"
Theme 14. The use of big data arrays in social programs	<i>Lecture-discussion</i> "Ensuring open access to big data as a sign of a democratic society." <i>Visual support banks</i> (examples of tables of socio-demographic indicators by observation units of different levels)
Theme 15. Development of a data collection project to monitor the behaviour of market participants	<i>Work in small groups</i> "Creation of a field economic research project. Organization of collection and storage of primary data and development of the plan for monitoring economic processes (optionally)" <i>Visual support banks</i> (typical templates of project schedules)

Various practical tasks complement the technical component of laboratory works and teach students not only to automatically perform a set of operations using software, but also to correctly set research objectives and choose the best solutions.

Using the methods of learning process activation

Theme of the discipline	Practical use of methodologies	Methodologies of learning process activation
Theme 1. Digital cartography	Theme of laboratory work 1: "Introduction to the interface of the geographic information system QGIS v. 3.x and its main functions. Configuring the workspace and main toolbars"	Use of visual support banks, work in small groups
Theme 2. Principles of navigation systems. Global positioning systems	Theme of laboratory work 2: "Preparation of statistical data for processing. Visualization of geographical maps based on analytical information. Working with map layers"	Work in small groups, cases
Theme 3. Processing of analytical data	Theme of laboratory work 3: "Complex queries and tools for processing fields and attribute table entries"	Use of visual support banks
Theme 4. GIS hardware and software requirements. Stages of spatial design	Theme of laboratory work 4: "Additional tools for data visualization. Construction of analytical graphs and charts based on geospatial information"	Brainstorming, presentations
Theme 5. Online services based on geoinformation technologies	Theme of laboratory work 5: "Creating maps with QGIS tools based on consumer requirements. Preparing maps for printing using the Print Layout module"	Brainstorming, working in small groups, business game, presentations
Theme 6. Requirements for the organization and processing of geospatial information in different	Theme of laboratory work 6: "Connection of additional QGIS modules. Integration with OpenStreetMap, Google Maps. Using the XYZ Tiles plugin"	Presentations, business game

Theme of the discipline	Practical use of methodologies	Methodologies of learning process activation
industries		
Theme 7. Modelling of geospatial tasks. Methods of data visualization	Theme of laboratory work 7: "Methods of digitization of raster maps. Selection of topographic standards"	Use of visual support banks
Theme 8. Types of spatial data and methods of computer presentation of geographical information	Theme of laboratory work 8: "Adding objects to the map based on the selected coordinate system. Working with point, linear and polygonal layers"	Brainstorming, cases
Theme 9. Cadastral zoning and territorial development planning	Theme of laboratory work 9: "Merging maps. Working with objects that have common borders or intersections"	Use of visual support banks, presentations
Theme 10. Integration of GIS with other tourist services	Theme of laboratory work 10: "Introduction to the Google Earth project. Tools and data types"	Use of visual support banks, brainstorming
Theme 11. Theoretical aspects of big data research	Theme of laboratory work 11: "Fundamentals of work in the R Studio application. Downloading data, installing libraries, calculating indicators via manual input of formulas"	Use of visual support banks
Theme 12. Legal regulation of the open data usage	Theme of laboratory work 12: "Methods of data visualization. Graphing in R Studio"	Use of visual support banks
Theme 13. The use of a system of satellite accounts in economic research of production and consumption of certain types of goods and services	Theme of laboratory work 13: "Principles of creating concept maps. Construction of a relational database scheme in the online application Lucidchart"	Brainstorming, work in small groups
Theme 14. The use of big data arrays in social programs	Theme of laboratory work 14: "Fundamentals of business process modelling using IDEF methodology and BPMN notation method in the online application Lucidchart. Building a decision tree. Introduction to DFD diagrams for depicting information flows"	Brainstorming, working in small groups, cases
Theme 15. Development of a data collection project to monitor the behaviour of market participants	Theme of laboratory work 15: "Creating a project layout in the application ProjectLibre. Construction of a Gantt chart, calculating the cost by stages of work"	Brainstorming, working in small groups, business game

The main differences between active and interactive teaching methods from traditional ones are determined not only by the methods and techniques of teaching, but also by the high efficiency of the educational process, which is proved by: high motivation of students; consolidation of theoretical knowledge in practice; raising the self-awareness of applicants; formation of the ability to make independent decisions, to make collective decisions, social integration; acquisition of conflict resolution skills; developing the ability to find compromises; self-determination of methods of scientific research in the process of economic research.

Procedure for evaluation learning outcomes

The system of assessment of the formed competencies of applicants depends on the types of classes, which according to the discipline curriculum includes lectures and laboratory classes, as well as independent work. Assessment of the formed competencies is provided according to the accumulative 100-point system on the scale of S. Kuznets. Control measures include:

current control, which is carried out during the semester at lectures and laboratory classes and is estimated by points (maximum score - 100 points; minimum score - 60 points);

module control, which is carried on the basis of current control for the relevant content module and aims at an integrated assessment of the applicant's learning outcomes after mastering the theoretical and practical material from the logically completed part of the discipline - the content module;

final / semester control is carried out in the form of test, the assessment consists of points obtained as a result of current control over the accumulative system.

Current control in this discipline is carried out in the following forms:

active participation at laboratory tasks (2 points for each lesson), provided that the applicant completes the minimum necessary part of the practical-calculation task in relation to the topic of the lesson; total number of points 30;

Forms of current assessment and methods of demonstrating learning outcomes:

presentations. During the semester, applicants must make presentations on topics 5 and 9; maximum score for each is 5 points (total 10 points);

competency-oriented tasks. During the semester, applicants perform a complex competency-oriented task, the sections of which correspond to the topics of the discipline; maximum score – 10 points (section to topics № 1-5 – 10 points, to topics № 6-10 – 10 points, to topics № 11-15 – 10 points) – total 30 points).

Module control is made in the form of a written test (on the topics of each module). The written test consists of five theoretical questions, each on the topics included in the current module, each question is evaluated separately (maximum 2 points for one question), overall assessment is the sum of the results. In the case of a fractional amount, the score is rounded in favour of the applicant. The maximum possible grade is 10 points, for the semester in total – 30.

The final score for the written module control is the sum of points for all tasks, which are rounded to an integer according to the rules of mathematics.

The criteria for evaluating the structural and logical sections of a **complex competence-oriented task** are:

ability to conduct critical and independent assessment of certain problematic issues; the ability to explain alternative views and explaining their own point of view on a particular issue; application of analytical approaches; quality and clarity of reasoning; logic, structuring and validity of conclusions on specific statistical indicators; involvement of the widest possible functionality of the software; independence of work performance; literacy of material submission; design of work.

The general criteria for assessing extracurricular **independent work** of applicants are: depth and strength of knowledge, level of thinking, ability to systematize knowledge on individual topics, ability to draw sound conclusions, mastery of categorical apparatus, skills and techniques of practical tasks, ability to find necessary information, to carry out its systematization and processing, self-realization in laboratory classes.

Final control of knowledge and competencies of applicants in the discipline is carried out in the form of test on the basis of accumulative credit transfer system - points obtained by current control, the task of which is to test the applicant's understanding of software as a whole, logic and relationships between individual sections, abilities to creative use of accumulated knowledge, the ability to formulate and perform research tasks based on reporting data.

The **applicant is certified** if the sum of points obtained by the results of the final / semester performance test ranges from 60 to 100. The minimum possible score for current and module control during the semester is 60 points.

The final grade in the discipline is calculated based on the score obtained during the current control over the accumulative credit transfer system. The total result in points for the semester is: "60 or more points - credited", "59 or less points - not credited" and is transferred to the "Statement of success" registry of the discipline.

The final grade is set according to the scale given in the table "Grade scale: national and ECTS".

Grade scale: national and ECTS

Total score on a 100 point scale	ECTS assessment scale	National scale	
		for exam, differentiated test, term project (work), practice, training	result
90 – 100	A	perfect	passed
82 – 89	B	good	
74 – 81	C		
64 – 73	D		
60 – 63	E	satisfactory	not passed
35 – 59	FX	non-satisfactory	
1 – 34	F		

Forms of assessment and distribution of points are given in the table "Rating plan of the discipline".

Rating plan of the discipline

№	Forms and types of education		Forms of assessment	max score
Theme 1	<i>Class work</i>			
	Lecture	Lecture on the theme "Digital cartography"	Work at the lecture	2
	Laboratory work	Laboratory work "Introduction to the interface of the geographic information system QGIS v. 3.x and its main functions. Configuring the workspace and main toolbars"	Active participation in laboratory work	
	<i>Individual work</i>			
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 2	<i>Class work</i>			
	Lecture	Lecture on the theme "Principles of navigation systems. Global positioning systems"	Work at the lecture	2
	Laboratory work	Laboratory work "Preparation of statistical data for processing. Visualization of geographical maps based on analytical information. Working with map layers"	Active participation in laboratory work	
	<i>Individual work</i>			
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 3	<i>Class work</i>			
	Lecture	Lecture on the theme "Processing of analytical data"	Work at the lecture	2
Laboratory work	Laboratory work "Complex queries and tools for processing fields and attribute table entries"	Active participation in laboratory work		

№	Forms and types of education		Forms of assessment	max score
	<i>Individual work</i>			
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 4	<i>Class work</i>			
	Lecture	Lecture on the theme "GIS hardware and software requirements. Stages of spatial design"	Work at the lecture	
	Laboratory work	Laboratory work "Additional tools for data visualization. Construction of analytical graphs and charts based on geospatial information"	Active participation in laboratory work,	2
		Execution of section 1 of the competence-oriented task	Chapter presentation	10
	<i>Individual work</i>			
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 5	<i>Class work</i>			
	Lecture	Lecture on the theme "Online services based on geoinformation technologies"	Work at the lecture	
	Laboratory work	Laboratory work "Creating maps with QGIS tools based on consumer requirements. Preparing maps for printing using the Print Layout module"	Active participation in laboratory work	2
		<i>Individual work</i>		
	Preparation for classes	Search, selection and review of literary sources on a given topic; підготовка презентації	Homework check	5
	Written test on the content module 1 (themes № 1 – № 5)		Test check	10
Theme 6	<i>Class work</i>			
	Lecture	Lecture on the theme "Requirements for the organization and processing of geospatial information in different industries"	Work at the lecture	
	Laboratory work	Laboratory work "Connection of additional QGIS modules. Integration with OpenStreetMap, Google Maps. Using the XYZ Tiles plugin"	Active participation in laboratory work	2
		<i>Individual work</i>		
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 7	<i>Class work</i>			
	Lecture	Lecture on the theme "Modelling of geospatial tasks. Methods of data visualization"	Work at the lecture	
	Laboratory work	Laboratory work "Methods of digitization of raster maps. Selection of topographic standards"	Active participation in laboratory work	2
		<i>Individual work</i>		
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 8	<i>Class work</i>			
	Lecture	Lecture on the theme "Types of spatial data and methods of computer presentation of geographical information"	Work at the lecture	

№	Forms and types of education		Forms of assessment	max score
	Laboratory work	Laboratory work "Adding objects to the map based on the selected coordinate system. Working with point, linear and polygonal layers"	Active participation in laboratory work	2
	<i>Individual work</i>			
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 9	<i>Class work</i>			
	Lecture	Lecture on the theme "Cadastral zoning and territorial development planning"	Work at the lecture	
	Laboratory work	Laboratory work "Merging maps. Working with objects that have common borders or intersections"	Active participation in laboratory work,	2
		Execution of section 2 of the competence-oriented task	Chapter presentation	10
	<i>Individual work</i>			
Preparation for classes	Search, selection and review of literary sources on a given topic; підготовка презентації	Homework check	5	
Theme 10	<i>Class work</i>			
	Lecture	Lecture on the theme "Integration of GIS with other tourist services"	Work at the lecture	
	Laboratory work	Laboratory work "Introduction to the Google Earth project. Tools and data types"	Active participation in laboratory work	2
	<i>Individual work</i>			
Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check		
Written test on the content module 2 (themes № 6 – № 10)			Control paper check	10
Theme 11	<i>Class work</i>			
	Lecture	Lecture on the theme "Theoretical aspects of big data research"	Work at the lecture	
	Laboratory work	Laboratory work "Fundamentals of work in the R Studio application. Downloading data, installing libraries, calculating indicators via manual input of formulas"	Active participation in laboratory work	2
	<i>Individual work</i>			
Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check		
Theme 12	<i>Class work</i>			
	Lecture	Lecture on the theme "Legal regulation of the open data usage"	Work at the lecture	
	Laboratory work	Laboratory work "Methods of data visualization. Graphing in R Studio"	Active participation in laboratory work	2
	<i>Individual work</i>			
Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check		

№	Forms and types of education		Forms of assessment	max score
Theme 13	<i>Class work</i>			
	Lecture	Lecture on the theme "The use of a system of satellite accounts in economic research of production and consumption of certain types of goods and services"	Work at the lecture	
	Laboratory work	Laboratory work "Principles of creating concept maps. Construction of a relational database scheme in the online application Lucidchart"	Active participation in laboratory work	2
	<i>Individual work</i>			
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 14	<i>Class work</i>			
	Lecture	Lecture on the theme "The use of big data arrays in social programs"	Work at the lecture	
	Laboratory work	Laboratory work "Fundamentals of business process modeling using IDEF methodology and BPMN notation method in the online application Lucidchart. Building a decision tree. Introduction to DFD diagrams for depicting information flows"	Active participation in laboratory work,	2
		Execution of section 3 of the competence-oriented task	Chapter presentation	10
	<i>Individual work</i>			
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Theme 15	<i>Class work</i>			
	Lecture	Lecture on the theme "Development of a data collection project to monitor the behaviour of market participants"	Work at the lecture	
	Laboratory work	Laboratory work "Creating a project layout in the application ProjectLibre. Construction of a Gantt chart, calculating the cost by stages of work"	Active participation in laboratory work	2
	<i>Individual work</i>			
	Preparation for classes	Search, selection and review of literary sources on a given topic	Homework check	
Written test on the content module 3 (themes № 11 – № 15)			Control paper check	10

Recommended literature

Main:

1. Geoinformation from the Past : Computational Retrieval and Retrospective Monitoring of Historical Land Use / H. Herold. – Springer Spektrum (Dresden, Germany), 2018. - 192 p.
2. Geospatial Technologies for All. Geospatial Technologies for All / A. Mansourian, P. Pilesjö, L. Harrie, R. van Lammeren. – Springer, 2018. – 382 p.
3. Spatial Modeling in GIS and R for Earth and Environmental Sciences / Editors H. R. Pourghasemi, C. Gokceoglu. – Elsevier, 2019. – 770 p.
4. Геоінформатика : навч. посіб. / В. І. Зацерковний, Л. В. Тустановська ; Київ. нац. ун-т ім. Т. Шевченка. - Київ : КНУ ім. Т. Шевченка, 2018. - 467 с.
5. Донченко М. В. Геоінформаційні системи : навчальний посібник / М. В. Донченко, І. І. Коваленко. – Миколаїв : Вид-во ЧНУ ім. Петра Могили, 2021. – 132 с.

Ancillary:

6. Konecny G. Geoinformation: remote sensing, photogrammetry and geographical information systems. – London : cRc Press, 2019 – 244 p.
7. Гевко І. Геоінформаційні системи і технології як інноваційні інструменти регіонального управління // Науковий вісник Миколаївського національного університету ім. В. О. Сухомлинського. Миколаїв: МНУ імені В. О. Сухомлинського. – 2018. – № 2(61). – С. 68-75.
8. Геоінформаційні системи на транспорті : навч. посібник / К. В. Доля, О. Є. Доля ; Харків. нац. ун-т міськ. госп-ва ім. О. М. Бекетова. – Харків : ХНУМГ ім. О. М. Бекетова, 2018. – 230 с.
9. Мацібора О. В. Веб-орієнтовані геоінформаційні системи та їх використання для обробки палеогеографічних даних // Український географічний журнал. – 2019. – № 1(105). DOI: <https://doi.org/10.15407/ugz2019.01.051>
10. Пашенко Р. Е. Проектування баз геоданих : конспект лекцій. - Харків : ХАІ, 2018. - 155 с.

Information resources:

11. Google Earth Tutorials. URL: <https://earth.google.com/studio/docs/tutorials/>
12. QGIS Documentation. URL: <https://documentation.qgis.org>
13. R Studio tutorials. URL: <https://data-flair.training/blogs/rstudio-tutorial/>
14. The official site of the Database of Global Administrative Areas (GADM). URL: <https://gadm.org>